

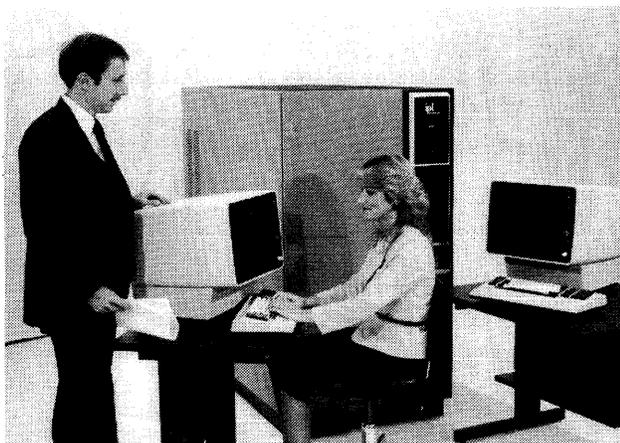
# IPL Systems 4400 Series

## MANAGEMENT SUMMARY

Until 1980, IPL had been building plug-compatible mainframes for OEM use only. The 4400 Series was introduced in 1980 and included four members. Two new members were introduced in 1983, which are the only machines currently manufactured by IPL. The original four members of the 4400 Series, the 4436, 4443, 4445, and 4446 are no longer being built; however, IPL still markets these models on a "used only" basis. The two newer models currently being manufactured are the 4460 and the 4480. Over the past year IPL has reduced prices on the two remaining models by up to 37 percent. The company has also designed and built CPUs in conjunction with Mitsubishi Corporation using advanced ECL large-scale integration gate array technology.

The primary objective in designing an IBM plug-compatible system is to make it literally transparent to IBM operating systems, systems software, applications, and IBM and IBM-compatible peripherals. IPL set out to not only achieve this objective, but to develop a system that 1) provides fault-tolerant architecture in the PCM marketplace, 2) incorporates state-of-the-art technology, 3) is easily field upgradable, 4) provides high reliability and maintainability, 5) offers substantially faster delivery times than the competition, and 6) provides better price/performance than the competition.

IPL has about 400 systems installed and on order worldwide, of which over 120 have been sold directly to end users in the U.S. With its expertise in microcode emulation, the company has been able to successfully counter IBM's 4300 announcements with products of its own. ▶



*Featuring six models with better price/performance than comparable IBM 4300 Series processors and a fault tolerant model, the IPL 4400 Series systems have from 4 to 16 megabytes of main memory, 5 to 10 channels, and are field-upgradable.*

The IPL 4400 Series of plug-compatible mainframes includes two systems with improved price/performance over their IBM 4300 Series counterparts. The systems require less floor space and power than the IBM products, and are all field upgradable to the next model.

**MODELS:** IPL 4460 and 4480.

**CONFIGURATION:** Main memory ranges from four to sixteen megabytes, and five to ten I/O channels are available.

**COMPETITION:** IBM 4341-12 and 4381-2; Cambex 1600 Series; NAS AS/6600 Systems.

**PRICES:** Purchase prices range from \$195,800 for a four-megabyte 4460 to \$513,400 for a 16-megabyte 4480.

## CHARACTERISTICS

**MANUFACTURER:** IPL Systems, Inc., 360 Second Avenue, Waltham, Massachusetts 02154. Telephone (617) 890-6620.

IPL Systems is a high technology company that was founded in 1973 to design and manufacture mid-range computer systems. The firm sells its products via OEM arrangements with such companies as Olivetti, Masstor, and international distributors. The company also markets its systems directly to end users under the IPL 4400 Series product name.

**MODELS:** IPL 4460 and 4480.

**DATE ANNOUNCED:** Model 4460, October 1982; Model 4480, February 1983.

**DATE OF FIRST DELIVERY:** 4460, 2nd Quarter 1983; 4480, 3rd Quarter 1983.

## DATA FORMATS

**BASIC UNIT:** 8-bit byte. Each byte can represent 1 alphanumeric character, 2 BCD digits, or 8 binary bits. Two consecutive bytes form a "halfword" of 16 bits, while 4 consecutive bytes form a 32-bit "word."

**FIXED-POINT OPERANDS:** Can range from 1 to 16 bytes (1 to 31 digits plus sign) in decimal mode; 1 halfword (16 bits) or 1 word (32 bits) in binary mode.

**FLOATING-POINT OPERANDS:** 1 word, consisting of 24-bit fraction and 7-bit hexadecimal exponent, in "short" format; 2 words, consisting of 56-bit fraction and 7-bit hexadecimal exponents, in "long" format; or 4 words in "extended precision" format.

**INSTRUCTIONS:** 2, 4, or 6 bytes in length, specifying 0, 1, or 2 memory addresses, respectively.

**INTERNAL CODE:** EBCDIC (Extended Binary-Coded Decimal Interchange Code). ▶

## IPL Systems 4400 Series

### ▷ PROCESSORS AND MAIN MEMORY

The IPL Series now consists of one single-processor model, the 4460, and one dual-processor model, the 4480, which use microcoding extensively to emulate IBM System/370 and 4300 Series operating features. The systems are composed of several distinct elements, such as the CPU, memory modules, input/output control units, and a service processor, which are connected to a high-speed internal link known as the ExpandaBus. All data transfers occur over the ExpandaBus, resulting in higher overall throughput. The ExpandaBus architecture actually is made up of three buses: the central data transfer bus, a main storage bus, and a control storage bus. The 4460 is field-upgradable to the 4480 and typically requires nothing more than changing a few plug-in modules in the system backplane.

The IPL systems include a high-speed multiply-divide unit, a feature which improves performance. Also included is support of the Start I/O Fast Release function. The 4480 consists of two independent processing units which share main storage. The 4480 can be configured either in a multiprocessor complex or as two uniprocessors. Main storage for the 4480 consists of 8, 12, or 16 one-megabyte modules which each have two ports. A spare one-megabyte module is also included, which can be operator-configured in the place of a failing storage module without a system break.

The central processor in all models uses emitter-coupled logic (ECL) circuitry, which is acknowledged to be superior to transistor-to-transistor logic (TTL) technology in areas such as performance, heat dissipation, and energy requirements. ECL technology also affords greater component packaging densities, resulting in reduced floor space requirements. The CPU features a 50-nanosecond cycle time.

The company uses 64K-bit chip technology in both models. All memory is error-correcting and corrects all single-bit errors and detects most multiple-bit errors. Memory cycle time is 500 nanoseconds for both read and write operations. The systems can have from four to sixteen megabytes of memory with buffer storage, or cache, for improving execution speeds. Models 4460 and 4480 have 24K bytes and 48K bytes of cache respectively. The system's operating features are implemented in microcode, which is contained in control storage. Model 4460 is equipped with 64K bytes of control storage while Model 4480 has 128K bytes.

IPL 4400 Series processors will operate with all IBM and IBM-compatible peripheral devices that are supported on System/370, 303X Series, and 4300 Series systems, except those devices requiring direct control or integrated controllers and adapters. The 4460 comes equipped with one byte and five block multiplexer channels. A channel set with one byte and four block multiplexer channels comes standard with each processor within the 4480. Byte multiplexer channels transfer data at 50K bytes per second in byte mode and 180K bytes per second in burst mode. Block multiplexer channels 1 and 2 can transfer data at up to 3 megabytes per second, and channels 3, 4, and 5 can transfer data at up to 2 megabytes per second. Data streaming, ▷

### ▶ MAIN STORAGE

**STORAGE TYPE:** 64K-bit chip technology.

**CAPACITY:** Model 4460, 4 to 16 megabytes in four-megabyte increments; and Model 4480, 8 to 16 megabytes in four-megabyte increments.

**CYCLE TIME:** 500 nanoseconds for both read and write operations.

**CHECKING:** All data paths between the central processor and main memory are parity-checked by byte. When data is stored, an error-correcting code is substituted for the parity bits. When the data is retrieved, single-bit errors are detected and corrected automatically, and most multiple-bit errors are detected and flagged for appropriate action.

**STORAGE PROTECTION:** The Store and Fetch Protection features, which guard against inadvertent overwriting and/or unauthorized reading of data in specified 2048-byte blocks of storage, are standard.

### CENTRAL PROCESSORS

The IPL 4400 Series processors are designed to execute the IBM System/370 instruction set, as well as special control functions associated with the IBM 4300 Series. The CPUs are highly modular in construction, and are built around a high-speed internal bus, known as the ExpandaBus.

The processors are heavily microcoded and have an internal cycle time of 50 nanoseconds. Extensive use of emitter-coupled logic (ECL) circuitry produces high internal speeds, while requiring less power and floor space and generating less heat than comparable systems. The use of ECL permitted the company to design a computer system which processed less data in each cycle than other comparable mid-range systems, but nevertheless achieved the desired performance by executing cycles at a much higher rate. Processing less data per cycle requires the use of less logic circuitry, hence reducing manufacturing costs and improving reliability and serviceability.

The system architecture is modular, with the CPU, main memory, input/output channels, and console functioning as independent subsystems interconnected by the ExpandaBus. System expansion and upgrading is easily accomplished by removing/replacing the required boards from the system. Maintenance is also made simpler since faulty components can be replaced in the field, once the specific problem has been determined. The 4460 is field-upgradeable to the 4480.

The system's operational characteristics are provided by microcode, a reloadable control program that is loaded into the system at power-up. Microcoding has made it possible for IPL, as well as its competitors, to quickly emulate architectural and functional changes in 4300 Series processors.

IPL's processors are equipped with dynamic address translation (DAT) which allows programs to be written using up to 16 megabytes of virtual storage in page sizes of 4096 or 2048 bytes. The conversion of a virtual address to a real address is done by a translation process using a set associative memory called Translation Lookaside Buffer (TLB). The size of the TLB was increased eight times with the announcement of the 4460. ▶

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TABLE 1. CHARACTERISTICS OF THE IPL 4400 SERIES PROCESSORS

	4460	4480
<b>SYSTEM CHARACTERISTICS</b>		
Relative performance level	1.65	2.70
Date announced	10/82	2/83
Date of first delivery	2nd Quarter 1983	3rd Quarter 1983
Virtual storage capability	Standard	Standard
Principal operating systems	DOS/VS, DOS/VSE, OS/VS1, SVS, MVS, MVS/SP, VM/370, VM/SP, SSX/VSE	MVS/SP, VM/SP
Upgradable to	4480	—
<b>MAIN STORAGE</b>		
Type	64K RAM	64K RAM
Cycle time, nanoseconds	500	500
Bytes fetched per cycle	8	8
Minimum capacity, bytes	2048K	8192K
Maximum capacity, bytes	16,384K	16,384K
Increment size, bytes	2048K	4096K
Error checking and correction	Standard	Standard
Processor cycle time, nanoseconds	50	50
Control storage:		
Capacity, bytes	128K	256K
Access time, nanoseconds	20	20
Buffer (cache) storage:		
Capacity, bytes	24K	48K
Access time, nanoseconds	100	100
<b>I/O CHANNELS</b>		
Number of channels:		
Standard	6	10
Maximum	6	10
Subchannels per channel (max.)	256	256
Maximum channel data rates:		
Block mode, bytes/second	3,000,000	3,000,000
Byte mode, bytes/second	180,000	180,000
Maximum aggregate data rate, bytes/second	11,000,000	18,000,000

➤ which is required with the high-performance IBM 3375 and 3380 (and equivalent) disk drives, is supported on channels 1 and 2.

The byte multiplexer channel can support up to 256 unshared subchannels, and each block multiplexer channel can support up to 256 subchannels.

### SOFTWARE AND SUPPORT

The IPL 4400 Series models, except the 4480 in a tightly coupled multiprocessor mode, are fully compatible with the following IBM operating systems: DOS/VS, DOS/VSE, OS/VS1, OS/VS2 (MVS and SVS), MVS/SP, VM/370, VM/SP, and SSX/VSE. The 4480, in a multiprocessor configuration, is supported by VM/SP and MVS/SP. Extended Control Program Support (ECPS) for VS1, DOS/VSE, MVS, and VM/370 is standard in all models. ECPS: VM can operate concurrently with ECPS:VM/370 or ECPS:VS1. IPL systems now support Cross Memory Services for ECPS:MVS.

➤ **COMPATIBILITY:** The IPL 4400 Series is compatible with the IBM System/370 and 4300 Series models with the following exceptions:

- Programs using machine-dependent data
- Programs that depend on features of I/O devices that are not implemented on the 4400 Series
- Programs that use main storage locations between address 128 and 736 (decimal) after a diagnostic logout to main storage

**PROCESSOR FEATURES:** The standard timing features of the System/370 architecture are included in the central processors. These include a CPU Timer and a Clock Comparator; the latter provides a means for causing an interrupt when the standard Time-of-Day Clock reaches a program-specified value. Additional instructions are provided to set and store the Time-of-Day Clock, Clock Comparator, and CPU Timer.

Additional features of the System/370 found in the IPL processors include control registers, a System/370 Commercial Instruction Set, a byte-oriented operand, conditional swapping, dynamic address translation, microprogrammed instruction retry, a double word buffer, an interval timer, machine check handling, a time-of-day clock, channel com-

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➤ System support is provided on several levels, all of which are available to a user if a malfunction occurs. The service processor, a component of the 4400 system, isolates system problems and initiates recovery measures. Information provided by the service processor makes it easier for local service personnel to correct the problem. Local support is subcontracted to Sorbus with 114 offices throughout the United States. Specialized hardware support is provided by Sorbus' regional and national technical support group. IPL's Technical Support Center, located at the company's headquarters in Waltham, MA, can link up, when a customer activated security key is enabled, with the system via a telephone connection. An IPL hardware/software specialist at Waltham can then operate the system remotely and run a series of diagnostic routines.

### COMPETITIVE POSITION

If the objective of a PCM is to offer better price/performance than comparable IBM 4300 Series products, then the 4400 Series certainly fills the bill. The newer 4460 is rated equal to the IBM 4341-12 at 1.6 million instructions per second (MIPS); however, the price is 40 percent less than the 4341-12. The 4480 competes with the IBM 4381-2. The IPL 4480 is rated at 2.7 million instructions per second while the IBM 4381-2 is rated at 2.5 million instructions per second. With the same amount of main memory (eight megabytes) and a better performance rating, the IPL 4480 is priced 18 percent lower than the IBM 4381-2. The 4480, according to IPL, is said to compete with systems manufactured by Tandem and Stratus in regard to fault tolerance; however, the 4480 is said to have a greater processing capacity than either the Tandem or Stratus machines, and has the advantage of IBM program compatibility.

### ADVANTAGES AND RESTRICTIONS

Considering the fact that IPL markets the 4460 to compete with the IBM 4341-12, the 4460 not only sells for significantly less, it comes standard with 8K more bytes of cache memory than the 4341-12. IPL claims that 16K bytes are allocated for operand data and the other 8K bytes are used for instructions.

Concurrent operation of ECPS:MVS and ECPS:VM/370 on all IPL 4400 systems is an advantage to IPL users. IBM also makes this feature available on models 4341-2 and 4341-12; however, IBM charges an additional \$26,000 for this option. IPL systems also feature concurrent operation of ECPS:VS1 and ECPS:VM/370, which is not offered at all on any IBM 4300.

While IBM does not offer a nonstop system, IPL offers the new model 4480, which is termed the "Continuous Compatible Computer." The company says that this system can "survive the vast majority of hardware failures and continue to function even while the failing component is being identified and replaced."

A typical installation of an IPL system is said to take an average of four hours because the mainframes are delivered in one frame that doesn't have to be bolted together. ➤

➤ mand retry, channel indirect addressing, a console audible alarm, a console file, advanced control program support, an extended control mode, and program event recording. Control registers are used for operating system control of relocation, priority interruptions, program event recording, error recovery, and masking operations. A double-word buffer consists of a 64-bit area temporarily reserved for data used in performing an I/O operation. Each channel attached to the CPU has a fixed amount of channel buffer dedicated to its use.

The interval timer is a 32-bit decremental counter that is reduced by one several hundred times per second. The timer generates an interrupt when the contained value is decremented from a positive to a negative number. Machine check handling analyzes errors and attempts recovery by retrying the failed instruction if possible. If retry is unsuccessful, it attempts to correct the malfunction or to isolate the affected task. The time-of-day clock is incremented once every microsecond and provides a consistent measure of elapsed time suitable for the indication of date and time. Some channels have the capability to perform channel command retry, a channel and control-unit procedure that causes a command to be retried without requiring an I/O interruption. Channel Indirect Addressing (CIA) is a companion feature of dynamic address translation, providing data addresses for I/O operations. CIA permits a single channel command word to control the transmission of data that crosses noncontiguous pages in real main storage. If CIA is not indicated, then channel one level (direct) addressing is employed.

The console audible alarm is a device activated when predetermined events occur that require operator attention or intervention for system operation. The console file is the basic microprogram loading device for the system, containing a read-only file device. The media read by this device contains all the microcode for field engineering device diagnostics, basis system features, and any optional system features. The extended control mode (EC) is a mode in which all features of the System/370 computing system, including dynamic address translation, are operational. Program event recording is a hardware feature used to assist in debugging programs by detaching and recording program events.

With the announcement of Model 4480, IPL introduced the concept of nonstop computing to the IBM compatible world. The 4480 consists of two completely independent processing units sharing a partitioned, dual-ported main storage. Each processing unit has its own instruction execution unit, control storage, channel set cache buffers, storage control unit, service processor, operator console, and power supplies. When operating in a tightly coupled, dual-processor configuration, a simplified image of the system is presented to the user in terms of peripherals, input and output queues, and system control. In contrast, the system may also be configured as two separate uniprocessor systems, providing continuous availability of a production system on one of the uniprocessors while software or hardware maintenance is running on the other.

Main storage receives power independently of the two processing units. It contains 8, 12, or 16 one-megabyte modules, each with two ports, and an active spare one-megabyte module. Either port can fail without affecting the other port and any storage module can fail without affecting the others. In the event of a storage module failure, the active spare module can be brought on-line without waiting for the field engineer.

**CONTROL STORAGE:** All 4400 Series processor operations are controlled by microprograms that reside in high-speed control storage. The standard control storage capacity is 64K bytes in Model 4460 and 128K bytes in Model 4480. Control storage can be increased to 128K bytes or 256K ➤

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➤ Another big advantage of the 4400 Series, aside from the obvious price/performance advantage, is its rapid delivery. Typically a user can have a system delivered within 30 days ARO.

One drawback that applies to the use of any plug-compatible mainframe is that the vendor usually does not market peripherals to sell with the CPU. In the case of the IPL machines, no integrated peripheral controllers are available. The IPL systems can utilize all IBM System/370 and 4300 Series input/output and mass storage subsystems, except those that require integrated controllers or adapters.

While the 4480 employs the tightly coupled approach to continuous, nonstop processing, one possible drawback that should be considered is that shared main storage can be a single failure point for both processors. IPL claims that this potential problem is minimized through the use of dual port independent access to each storage module and the unique partitioning of main storage into one-megabyte module field replaceable units.

### USER REACTION

In the 1984 Computer Users Survey, we received 12 responses from IPL 4400 Series users. All of the respondents had one system installed. Four of the systems were purchased; eight were rented or leased from the vendor. Three users had converted from IBM systems and three had converted from the Omega from Control Data Corporation. The companies were in the following businesses: service bureaus, entertainment, software development, transportation, and manufacturing. The majority of applications programs in use included payroll, order processing, insurance, and software development.

The majority of installations had between six and fifteen local terminals in use; however, six installations had no remote terminals attached. Four installations each had two to four megabytes, four to eight megabytes, and eight to sixteen megabytes of main memory, respectively. Operating systems software included DOS/VSE, OS/VS1, OS/MVS, and EDOS/VS. Eleven users were running Cobol. Plans for 1984 included additions to software, data communications, and hardware.

Twelve users said that the systems had done what was expected of them. Eleven users said they would recommend the system to another user. Several distinct categories were also rated as being either Excellent, Good, Fair, or Poor. When looking at these ratings, the reader should be aware of the fact that the categories under "Reliability of Peripherals" and "Manufacturer's Software" reflect system components not provided by IPL. These ratings have been compiled in the following chart.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	8	3	1	0	3.6
Reliability of system	10	1	1	0	3.8
Reliability of peripherals	4	6	2	0	3.2

➤ (4480) if required. This is sufficient to hold the microcode required for the System/370 Universal Instruction Set and all of the standard software assist features. The microprograms are loaded into control storage by means of a diskette unit called the Console File.

**REGISTERS:** Model 4460 has sixteen 32-bit general-purpose registers and eight 64-bit registers. Model 4480 has two-by-sixteen bit general-purpose and two-by-eight 64-bit floating point registers. These registers can be used for indexing, base addressing, and as accumulators.

**INSTRUCTION REPERTOIRE:** The System/370 Universal Instruction Set is standard in the 4400 Series processors.

**OPERATIONAL MODES:** The Extended Control (EC) and Extended Control Program Support (ECPS) features are standard on the 4400 Series processors. As a result, all models can operate in any of the following modes: Basic Control (for System/360 programs); Extended Control (for programs that require dynamic address translation); ECPS:VS1 (which uses microcoding to improve system performance under the VS1 operating system); ECPS:VM/370 (which provides improved system performance under VM/370); ECPS:VSE mode, which uses microcoding to reduce overhead and improve system throughput under DOS/VSE; and ECPS:MVS, which provides improved performance when operating under MVS. In addition, all three announced releases of MVS/SP can operate in native mode or concurrently with ECPS:VM.

**PERFORMANCE:** IPL rates its 4400 Series models in terms of relative performance compared to comparable IBM 4300 Series models based on the IBM 4341-1 with a relative performance of 1.0. Using figures supplied by IPL, here's how IPL and IBM processors measure up:

Manufacturer	Model	Relative Performance
IPL	4480	2.70
IBM	4381-2	2.50
IPL	4460	1.65
IBM	4341-12	1.65

The IPL Systems feature a high-speed multiply-divide unit, which improves performance. These systems also include support of the Start I/O Fast Release function which avoids having the CPU wait for peripheral devices to respond to start I/O commands.

**BUFFER STORAGE:** Each 4400 Series model has a cache buffer to provide improved system throughput. The buffer stores selected areas of main storage that might be used next by the CPU. If the requested data is contained in the cache, the CPU request can be handled rapidly. The 4460 has up to 24K bytes of cache and the 4480 can have up to 48K bytes. The 4460 has 16K bytes of operand cache memory when using 4K-byte pages in addition to the 8K-byte instruction cache.

**CONSOLE:** A system console is supplied with the 4400 Series central processor models. It consists of a control panel, keyboard, CRT display, the Console File (a pair of diskette drives used to load the 4400 microcode and system diagnostics into control storage), and an optional console printer. The system console can operate in either of two modes, as selected during the initial microprogram load (IMPL) procedure.

• Display mode, in which the CRT and keyboard appear to the operating system as an IBM 3277 Model 2 Display Station with keyboard. This mode requires the Device

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	Excellent	Good	Fair	Poor	WA*
Maintenance service:					
Responsiveness	4	6	1	1	3.1
Effectiveness	4	8	0	0	3.3
Technical support:					
Troubleshooting	4	7	1	0	3.3
Education	4	2	2	2	2.8
Documentation	4	3	2	1	3.0
Manufacturers software:					
Operating system	4	2	1	0	3.4
Compiler & assemblers	5	3	0	0	3.6
Application programs	2	4	1	0	3.1
Ease of programming	2	4	0	1	3.0
Ease of conversion	1	4	0	1	2.8
Overall satisfaction	3	3	1	0	3.3

\*Weighted Average on a scale of 4.0 for Excellent.

Datapro spoke with two IPL users to find out how the systems perform. We first called an IPL 4446 user, a service bureau, who had converted from the Omega from Control Data Corporation. The user indicated that they had looked at comparable machines offered by IBM and Magnuson before deciding on IPL. He said that the price was the primary reason for their choice. The user said that although they are quite pleased with the IPL system, some of the problems they have had with peripherals may have been resolved more quickly if they had also been purchased from the mainframe vendor. Overall, the user is satisfied with the system and would recommend it to a prospective buyer.

The second user we talked to is a very new user of IPL systems. The IPL 4460 is being used by a communications company on the East Coast. According to the user, the system was installed on a moment's notice. The system was not converted to from any other machine. The 4460 was chosen because of the amount of power it offers at such a low price. According to the user, IPL had the system installed in a very short amount of time with a lot of "hand-holding." Spare parts were acquired quickly when needed. The user also said that the 4460 interfaces well with the peripherals offered by other vendors. No major problems have been encountered thus far; however, the reader is reminded that this is a very new installation. □



**Independent Display Operator Console Support (DIDOCs) software or its equivalent.** If the optional console printer is included, it requires the Multiple Console Support (MCS) software or its equivalent and must be addressed separately as an IBM Console Printer.

- **Printer-keyboard mode**, in which the CRT, keyboard, and optional console printer appear to the operating system as an IBM 3215 Console Printer-Keyboard. This mode is supported by DOS, DOS/VS, OS, OS/VS, and VM/370.

The system console also contains the Service Processor, a microprocessor for diagnostic functions, and a remote data link facility that provides on-line communications with a remote console, such as the one at IPL's Worldwide Technical Support Center at its Waltham headquarters. The data link enables personnel at the Support Center to operate the user's system remotely in order to diagnose both hardware and software problems.

The CRT(s) associated with the console can be located up to 30 feet from the CPU. IPL supports up to three additional CRTs and printers at the console on Model 4460 and up to six additional CRTs and printers on Model 4480. IPL also supports IBM 3278 2A, 3279 2C, and compatible terminals.

**PHYSICAL SPECIFICATIONS:** The 4400 Series processors are housed in the same cabinet, which can contain the maximum 16 megabytes of memory. The 4400 typically requires about one-third less floor space than an IBM 4341, when equipped with the standard system console. Listed below are the dimensions and power requirements of the basic 4400 Series models, including the console.

### Dimensions:

Width, in. (cm)—31.5 (80)  
Depth, in. (cm)—63 (160)  
Height, in. (cm)—60 (153)  
Weight, lb. (kg)—2000 (907)

### Power requirements:

Voltage—208V ± 10%  
Phases—3  
Frequency, Hz—60 ± 0.5

Heat dissipation, Btu/hr.—10,000 for the 4460 and 17,000 Btu/hr. for the 4480.

Environmental requirements for all models are as follows: operating temperature range—60 to 90 degrees Fahrenheit (15 to 32 degrees Celsius); relative humidity range—20 to 80 percent.

## INPUT/OUTPUT CONTROL

The IPL 4400 systems support one byte multiplexer channel and up to five block multiplexer channels. Each byte multiplexer channel has 256 unshared subchannels and can address up to 256 devices. Similarly, each block multiplexer channel can have up to 256 subchannels. Unit control words (UCWs) can be dynamically assigned from a pool of 432 unshared and 16 shared UCWs.

The maximum byte multiplexer channel data rate is 50,000 bytes per second in normal operating mode and 180,000 bytes per second in burst mode. Any block multiplexer activity reduces the byte multiplexer data rate.

Block multiplexer channels 1 and 2 have a maximum data rate of 3.0 million bytes per second (Data Streaming), and block multiplexer channels 3 through 5 have a maximum rate of 2.0 million bytes per second. The aggregate data rate for all block multiplexer channels in a 4460 system is 11 million bytes per second. For Model 4480, the aggregate block multiplexer data rate is 18 million bytes per second. Block multiplexer channels can operate as selector channels where they control one operation at a time.

A unique double-word buffer that provides greater levels of throughput is included with each block multiplexer channel.

Each of the processors within the 4480 comes equipped with its own independent channel set with one byte multiplexer channel and four block multiplexer channels. These dual independent channel sets allow for one of the processors to be taken off-line and used to isolate and repair a failing path while the system continues to run as a uniprocessor.

**SIMULTANEOUS OPERATIONS:** Concurrently with computing, a 4400 Series processor can control a maximum of one high-speed I/O data transfer operation on each block multiplexer channel and one low-speed I/O data transfer operation on each subchannel of each byte multiplexer channel, subject to the maximum channel and aggregate

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► data rates specified above. Alternatively, a byte multiplexer channel can operate in burst mode and handle a single high-speed I/O operation instead of multiple low-speed operations.

## CONFIGURATION RULES

IPL 4400 systems can be configured in essentially the same manner as IBM System/370 and 4300 Series computer systems, except that no integrated peripheral controllers are available for the IPL computers.

## PERIPHERAL EQUIPMENT

The IPL 4400 can utilize all IBM System/370 and 4300 Series input/output and mass storage subsystems, except those that require integrated controllers or adapters, as well as the plug-compatible counterparts of these IBM subsystems offered by other vendors. Detailed coverage of many of these peripherals can be found in Volume 2 of DATAPRO 70.

## SOFTWARE

All of the current 4400 Series computer systems, except the 4480 in a tightly coupled configuration, fully support the following IBM operating systems: DOS/VS, DOS/VSE, OS/VS1, OS/VS2 (SVS and MVS), VM/370, and SSX/VSE. Detailed descriptions of these operating systems can be found in the IBM 4300 Series report (70C-504MK-301). Extended Control Program Support (ECPS) for VS1, DOS/VSE, MVS, and VM/370 is standard in all models. Concurrent operation of ECPS:VM and ECPS:VS1 or ECPS:MVS is also standard in all models. To increase the performance of MVS/SP Release 3 running on its systems, IPL plans to include a Cross Memory Services (Dual Address Space) enhancement to ECPS:MVS.

When Model 4480 is operated in a tightly coupled, multiprocessor complex, it is supported by OS/MVS 3.8, OS/MVS

SP 1.1 or higher, or VM/SP Release 1 or higher. When it is run as two uniprocessors, it is supported by all operating systems supported on Model 4460.

## PRICING

IPL 4400 Series systems are available on a direct purchase basis, or two-, three-, four-, and five-year third-party leases. Two-year lease prices are provided in this report. For additional lease prices, contact IPL. The cost for a system upgrade is also listed in this report.

Since Model 4480 is considered a single processing complex, only a single license fee is needed for each IBM licensed program whether the 4480 is operated as a tightly coupled dual processor or as two separate uniprocessor systems.

IPL provides support through 114 Sorbus offices throughout the country. Sorbus' hardware/software specialists are trained by IPL to handle problems that arise at a local level. IPL's Technical Support Center, located in Waltham, MA, can also be contacted, and a communications link is established in order to isolate and correct system malfunctions.

With the June 1981 announcement by IBM of its intention to provide System Installation Productivity Options (SIPOs) for non-IBM users, the way was cleared for IPL and other plug-compatible vendors to function as a user's agent in dealing with IBM for specific SCP and other licensed IBM program products.

The minimum monthly maintenance charges, as shown in the following price list, include support for both hardware and SCPs for one shift per day, five days per week. Full maintenance coverage for 24 hours per day, seven days per week is available. Maintenance is included in the monthly rental and lease figures.

## EQUIPMENT PRICES

		Purchase Price (\$)	Monthly Maint. (\$)	3-Year Lease (\$)
<b>PROCESSORS</b>				
	Model 4460 Processor; includes CPU with 50-nanosecond cycle time, 500-nanosecond main memory, one byte multiplexer and five block multiplexer channels, 16K byte or 24K byte high-speed buffer storage, 64K bytes of control storage, and system console			
4460-4	4,096,000 bytes of memory	195,800	964	9,400
4460-8	8,192,000 bytes of memory	228,800	1,084	10,995
4460-12	12,228,000 bytes of memory	261,800	1,204	12,590
4460-16	16,384,000 bytes of memory	294,800	1,324	14,185
	Model 4480 Processor Complex; includes two tightly coupled CPUs, each with 50-nanosecond cycle time, 500-nanosecond dual ported main memory, one byte multiplexer and four block multiplexer channels, 24K byte high-speed buffer storage, 64K bytes of control storage, and system console			
4480-8	8,192,000 bytes of memory plus 1,096,000 bytes active spare memory	443,000	1,054	21,450
4480-12	12,288,000 bytes of memory plus 1,096,000 bytes active spare memory	478,200	1,204	23,100
4480-16	16,384,000 bytes of memory plus 1,096,000 bytes active spare memory	513,400	1,324	24,750
<b>SYSTEM OPTIONS</b>				
1604	4,096,000 byte memory increment	30,000	60.00	—
1701	Hardware upgrade kit for over four megabytes of memory	7,785	16.50	—
1702	Power Sequence Extension (16 control units)	1,805	6.50	—
1801	Console Printer	5,250	60.50	—
1805	Additional 3278 CRT keyboard	3,515	60.50	—
1806	3279 2C CRT keyboard	5,535	60.50	—
1950	Channel to Channel Adapter	22,500	30.00	605
2001	Third and fourth block multiplexer channels	11,760	11.00	275
2002	Fifth block multiplexer channel	5,880	5.50	135